

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of:

Attorney Docket No.: 3081.126US01

Peter Westphal et al.

Confirmation No.: 8968

Application No.: 10/552,557

Examiner: Derek S. Chapel

Filed: October 11, 2005

Group Art Unit: 2872

For: MICROSCOPE ARRANGEMENT

DECLARATION UNDER 37 C.F.R. 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

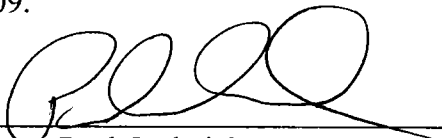
Sir:

I, Paul Onderick, herein declare:

1. That the attached is a true and correct copy of excerpts from *Modern Cosmology* edited by S. Bonometto, V. Gorini and U. Moschella.

That further the declarant sayeth not.

Signed this 4th day of February, 2009.



Paul Onderick

Declaration prepared by
Paul C. Onderick
Registration No. 45,354

Patterson, Thunte, Skaar & Christensen, P.A.
4800 IDS Center
80 South 8th Street
Minneapolis, Minnesota 55402-2100
Telephone: (612) 349-5774

Exhibit A

INSTITUTE OF PHYSICS

SERIES IN HIGH ENERGY PHYSICS,
COSMOLOGY AND GRAVITATION

MODERN COSMOLOGY

EDITED BY
S BONOMETTO
V GORINI
U MOSCHELLA

IoP

MODERN COSMOLOGY

Edited by

Silvio Bonometto

*Department of Physics,
University of Milan—Bicocca, Milan*

Vittorio Gorini and Ugo Moschella

*Department of Chemical, Mathematical and Physical Sciences,
University of Insubria at Como*

IOP

INSTITUTE OF PHYSICS PUBLISHING
BRISTOL AND PHILADELPHIA

© IOP Publishing Ltd 2002

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publisher. Multiple copying is permitted in accordance with the terms of licences issued by the Copyright Licensing Agency under the terms of its agreement with the Committee of Vice-Chancellors and Principals.

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library.

ISBN 0 7503 0810 9

Library of Congress Cataloging-in-Publication Data are available

Commissioning Editor: James Revill
Production Editor: Simon Laurenson
Production Control: Sarah Plenty
Cover Design: Victoria Le Billon
Marketing Executive: Laura Serratrice

Published by Institute of Physics Publishing, wholly owned by The Institute of Physics, London

Institute of Physics Publishing, Dirac House, Temple Back, Bristol BS1 6BE, UK

US Office: Institute of Physics Publishing, The Public Ledger Building, Suite 1035, 150 South Independence Mall West, Philadelphia, PA 19106, USA

Typeset in L^AT_EX 2_ε by Text 2 Text, Torquay, Devon
Printed in the UK by MPG Books Ltd, Bodmin, Cornwall

The Schwarzschild radius for a body of mass M is given by

$$R_S = \frac{2GM}{c^2}, \quad (14.8)$$

thus the absolute value of the deflection angle can also be written as $\alpha = 2R_S/b$. For the Sun the Schwarzschild radius is 2.95 km, whereas its physical radius is 6.96×10^5 km. Therefore, a light ray which just grazes the solar surface is deflected by an angle corresponding to $1.7''$.

14.2.2 Thin lens approximation

From these considerations one sees that the main contribution to the light deflection comes from the region $\Delta z \sim \pm b$ around the lens. Typically, Δz is much smaller than the distance between the observer and the lens and the lens and the source, respectively. The lens can thus be assumed to be thin compared to the full length of the light trajectory. Thus one considers the mass of the lens, for instance a galaxy cluster, projected onto a plane perpendicular to the line of sight (between the observer and the lens) and going through the centre of the lens. This plane is usually referred to as the lens plane and, similarly, one can define the source plane. The projection of the lens mass on the lens plane is obtained by integrating the mass density ρ along the direction perpendicular to the lens plane:

$$\Sigma(\xi) = \int \rho(\xi, z) dz, \quad (14.9)$$

where ξ is a two-dimensional vector in the lens plane and z is the distance from the plane. The deflection angle at the point ξ is then given by summing over the deflection due to all mass elements in the plane as follows.

$$\alpha = \frac{4G}{c^2} \int \frac{(\xi - \xi') \Sigma(\xi')}{|\xi - \xi'|^2} d^2 \xi'. \quad (14.10)$$

In the general case the deflection angle is described by a two-dimensional vector. However, in the special case that the lens has circular symmetry one can reduce the problem to a one-dimensional situation. Then the deflection angle is a vector directed towards the centre of the symmetry with absolute value given by

$$\alpha = \frac{4GM(\xi)}{c^2 \xi}, \quad (14.11)$$

where ξ is the distance from the centre of the lens and $M(\xi)$ is the total mass inside a radius ξ from the centre, defined as

$$M(\xi) = 2\pi \int_0^\xi \Sigma(\xi') \xi' d\xi'. \quad (14.12)$$